METHODS OF ANALYSIS FOR FOREST LAND USE ALLOCATION IN BRITISH COLUMBIA: OPTIONS AND RECOMMENDATIONS

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September 1990

Prepared For The British Columbia Round Table On The Environment And The Economy

ROUND TABLE

91-04310/

PREFACE

"Methods of Analysis For Forest Land Use Allocation in British Columbia: Options and Recommendations" was prepared by Dr. Thomas Gunton and Dr. Ilan Vertinsky as part of a project funded jointly by the British Columbia Forest Resources Commission and the British Columbia Round Table on the Environment and the Economy. It is part of a series of background reports dealing with issues which the Round Table considered important to the development of a sustainable development strategy in British Columbia. It is intended to provide information that will assist the dialogue between the Round Table and the public.

The Round Table has not endorsed the report. The information provided and conclusions reached in this document are those of the authors.

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EXECUTIVE SUMMARY

Methods Of Analysis For Forest Land Use Allocation In British Columbia: Options and Recommendations

This background report focuses on alternative techniques for analyzing land use options, including biophysical overlays, decision analysis, benefit-cost, and multiple accounts.

The authors describe and evaluate each technique, and conclude that an analysis framework based on multiple accounts is the most appropriate for land use tradeoffs. This technique allows the decision maker to consider the alternatives in terms of their contributions to different objectives such as economic development, environmental quality, and social well-being.

The authors also conclude that public participation in the process is necessary, that standardized guidelines for land allocation must be developed, and that guidelines should be prepared for an integrated geographical information system for use by all agencies.

1.0 INTRODUCTION

An essential component of the decision-making process is the generation of technical information assessing the consequences of alternative land use strategies. The purpose of this report is to summarize a series of background papers reviewing alternative analytical techniques for analyzing land use options. Techniques reviewed include biophysical overlays, decision analysis, cost-benefit analysis and multiple accounts.

The conclusion of this review is that a technique based on multiple accounts is the most appropriate technique for analyzing land use tradeoffs. We also conclude that guidelines describing the appropriate application of these techniques should be developed. For more detailed discussion of the techniques, the appropriate background studies should be consulted.

2.0 THE ATTRIBUTES OF A GOOD TECHNIQUE

A choice of a technique presumes appropriate compromise between its advantages and disadvantages. The compromise depends on the nature of the problem and the preferences of the decision maker.

The following dimensions for evaluating a decision technique are based on a review of the literature cited in the relevant background reports:

(1) Comprehensiveness: Does the approach accommodate a comprehensive problem definition, reflect the uncertainty surrounding technical issues, incorporate social values and accommodate new information and insight?

(2) Logical Soundness: Does the approach provide a timely and logically defensible summary of all that it deals with? Are the conclusions derived from decision rules which are sensitive to information, reliable, suitable to the problem at hand and unbiased?

(3) Practicality: Is the approach implementable given the analytic resources, the time and financial constraints, and the constraints in the information base?

(4) Openness to Evaluation: Can assumptions and values underlying the technique be easily identified and their impacts assessed? Is there a clarity of conceptual framework and well-defined procedures?

(5) Political Acceptability and Compatibility with Existing Institutions: Can the technique be implemented given the political and institutional realities without being rejected or overwhelmed by these realities? Can the technique be understood by the public and politicians?

(6) Conduciveness to Learning: Does the application of the technique educate the participants?

(7) Flexibility: Can the technique deal with different situations? and

(8) Decisiveness: Does the technique facilitate choice?

3.0 THE CURRENT STATE OF ANALYSIS IN FOREST LAND USE PLANNING

Typically, the decision to adopt a particular plan in British Columbia reflects a process of bargaining and compromise involving representatives of different ministries in charge of different forest resources. Each ministry (and sometimes departments and branches of the same ministry) employs different analytic techniques to identify what is best from its resource use perspective and to assess the impact of other proposed resource uses. The methods used range from the application of professional judgment to the employment of sophisticated computer optimization techniques. For example, the MOF uses simulation

and linear programming models to determine the best harvesting and silvicultural strategy given alternative constraints proposed by the advocates of non-timber uses (e.g., wildlife). The application of these models allows representatives of the MOF to assess the consequences of accommodating non-timber uses in terms of timber values lost. The choice usually is arrived at through informal, unstructured bargaining.

The Resource Planning Manual developed by MOF in 1985 outlines the steps that should be used in the preparation of TSA plans. The steps include informal issue identification which triggers invitations of input from other agencies and the public. This is followed by information assembly involving the systematic identification and synthesis of forestry and other data. Options for alternative uses are generated informally. A baseline option representing the historical or present situation is also included. Options generated are then represented as adjustments to the productive forest land base in the timber supply analysis. Computer optimization models are used to analyze timber supplies. For each option, the associated timber production and future timber volumes available for harvest are computed. Both range and recreation analyses are conducted at this stage as well. The forecasted consequences for each option are compared to the production goals for each resource. At this stage, options which appear to satisfy best the production goals are selected for the consideration of the decision maker.

The problems that implementation of this process encounter are the lack of systematic, compatible assembly of information by the various agencies, the ad hoc nature of issue identification and the lack of an explicit evaluation framework which reconciles assumptions and values in a consistent way.

The MOF is now involved in a major effort to correct some of these flaws. An Analytic Framework for Integrated Resource Management (AFIRM) is being developed in

an attempt to systematize and coordinate the analysis of all resources in a TSA. This will be done through the use of a georeferenced data base, a generalized process of resource land base allocation and projection, and a set of management options which pertain to all of the resources in the TSA. Even in this design, the analytic technique for the forest land use allocation decision is left unstructured. However, in a few situations involving high conflict, the ministry has employed the framework of cost-benefit analysis as an input to the decision process.

4.0 BIOPHYSICAL ANALYSIS

The underlying assumption of biophysical analysis is that the utility of land to support alternative uses is based on its biophysical attributes. The application of the method is relatively straightforward: biophysical characteristics of the land area are evaluated, described and summarized on maps. A rating system is devised for each prospective land use such as agriculture, recreation and forestry. Capability maps are then generated for each prospective land use based on the classification system and the biophysical features.

Different biophysical attributes of an area may limit or facilitate a particular land use. Beginning with a knowledge of land use requirements, capability ratings can be determined either by evaluating use limitations relative to the optimal land type, or by compiling a list of specific opportunities offered by the area.

Perhaps the best-known Canadian example of a capability rating system is the Canada Land Inventory (CLI). Most ratings in the CLI are based on limitations to use such as soil fertility, soil moisture and slope limitations to agriculture or forestry food and cover availability for wildlife. Recreation ratings, conversely, are based on specific opportunities, such as beaches, water access, and scenic features. The CLI ratings are for use capability as

defined above; that is, inherent productive potential with economically and technically feasible improvements.

After the potential for each prospective land use is evaluated for the entire study area, these ratings can be synthesized into a composite land use map. Such a map might indicate the best prospective use for each unit in the area together with compatible secondary uses. Alternatively, it could distinguish between areas capable of supporting only a single use, and those capable of supporting several. Maps recommending best uses must show clearly the criteria used for the decision. The second type of map is useful in pointing out areas of potential conflict requiring further analysis of the potential for multiple use, or the need for tradeoffs.

Faced with a composite land use evaluation map, the decision maker can decide on a land use plan for the study area. The basis of any decision must be a set of criteria or objectives against which to compare land use alternatives. A set of objectives might include, for example, a specific timber harvest and number of visitor days of recreation potential. Planners could then examine alternative land use combinations shown as biophysically possible on the composite evaluation map. By comparing these alternatives to the stated objectives, the decision maker would choose the best land use combination.

The availability of high-powered, fast computers allows the implementation of the biophysical analysis system with more flexibility and display capabilities that facilitate professional judgment and bargaining.

Geographic Information Systems (GIS) can be used to overlay data and information themes pertinent to the management of each resource. Composite maps can easily be

created to aid the biophysical analysis and help decision makers decide upon use trade-offs by experimenting with alternatives in the GIS environment.

4.1 Evaluation of Biophysical Analysis

The advantages of biophysical analysis are that it is flexible and easy to understand. It provides a structure for information concerning resource use. Also, with the powerful GIS systems now available it can facilitate informed discussion and bargaining about forest land uses. The problem with biophysical analysis is its lack of a systematic conceptual framework for generating biophysical capability ratings and its exclusion of significant factors such as economic criteria. The framework provided by biophysical analysis is not oriented to decision making, except for its use as a screening device (showing what the land is not capable of producing) and a device to highlight conflict potential. This said, it should be emphasized that a biophysical standardized geographic information system is necessary in the implementation of any formal or informal informed decision technique.

To develop a standardized system, it is important for all participating agencies and organizations dealing with forest land to agree on common definitions, assumptions and basic geographic management units. Such an information system should provide at the minimum, site-specific resource capabilities and limitations, biophysical attributes and information about spatial relationships between resources and users. In addition, the system should provide information about uses and capabilities over time.

5.0 DECISION ANALYSIS

5.1 The Value Assumptions of Decision Analysis

Decision analysis presumes that there is a single decision maker or a group chartered to speak on behalf of society. It assumes that the decision makers can fully and consistently articulate their preferences among alternative states of the world. These preferences can be described by a unit called utility. The objective is the maximization of the expected value of utility. The method uses the decision maker's judgments to derive the utility function. In this process, attitudes toward risk and different timing of consequences are also accommodated.

Decision Analysis allows an explicit representation of the preferences of the decision maker, imposing only some plausible requirements of rationality of judgment and permitting the decision maker to identify those consequences that affect the desirability of an alternative. The technique imposes little in terms of the content of what should be desired. Thus, for example, if the decision maker considers "satisfying the demand of group X" to be an important objective, it can be included in the choice process using decision analysis.

5.2 The Decision Analysis Method

There are four basic steps in applying decision analysis. The first step consists of structuring the problem, i.e., determining objectives, identifying alternatives, and defining measures of effectiveness for each objective (attributes). The second step consists of the assessment of the possible consequences of each alternative. This includes quantification

in terms of the attributes, timing and uncertainty involved with each alternative. The third stage includes the determination of the preference or value structure. Through a process of questioning the decision maker, it involves the construction of a mathematical function which indicates the ranking of alternative consequence scenarios described by their attributes (this function is called a utility function).

Consider, for example, a decision maker who is interested in only two objectives: employment and forest preservation. The attributes could be defined by the decision maker as percentage of labour force employed and the old-growth trees remaining as percentage of current stock. The utility function allows the analyst to rank alternatives such as (1) an option that ensures preservation of 80% of old-growth forest, while involving a 50% chance of 93% employment rate (or 7% unemployment) and a 50% chance of 95% employment versus (2) an option which will allow a 90% chance of preserving 80% of the old forest and a 10% chance of preserving 70% of the old forest, but creating a higher employment level of 96%, for sure. The process of deriving the utility function involves posing many such choices to the decision maker and inferring (with the aid of assumptions) from the responses the general shape of the function (not an easy task of judgment!).

The fourth step of decision analysis is the evaluation and comparison of the alternatives. This step includes using the utility function to obtain the ranking of all the alternatives considered. Typically the analysis will now include an examination of the choice in terms of its sensitivity to preferences and consequences.

5.3 Evaluation of Decision Analysis

The advantage of decision analysis is that it allows flexibility in terms of objectives, definition and measurement of effectiveness. It allows an expression of subjective preferences among timings of consequences and the degree of uncertainty which is involved. The technique is transparent, the assumptions are minimal, and data bases can be used in conjunction with judgment to ensure comprehensiveness. The technique encourages a systematic approach to problem solving and provides a framework for sensitivity analysis.

The major disadvantage of the technique is that it requires the identification of an "authorized" voice for society and that the spokesperson or persons selected have a consistent preference structure that represents true social preferences. The technique also requires agreement on probabilities and problem structure, since all these are subjective elements. In society there is rarely one individual or organization that is the final arbiter of social preferences, probabilities and appropriate problem structure. The technique's main usefulness, therefore, is to articulate alternative points of view in the decision process in a way which is accessible to other participants in the process. This may lead to a focus in a negotiation process upon the true elements of conflict. Although such focusing and clarification of conflict may facilitate negotiations and agreement, it can also lead to polarization of views.

6.0 COST-BENEFIT ANALYSIS (CBA)

6.1 The Value Assumptions of Cost-Benefit Analysis

Cost-benefit analysis is much more directive with respect to what is desirable. It assumes that the primary social objective is economic efficiency. The desired state is the one which provides the total maximum value of production and consumption opportunities to society given the existing distribution of wealth. This means that the forest land use allocation which provides the highest net benefits in terms of consumption opportunities should be selected. The valuation of costs and benefits is reflected by the willingness of the people in the system to pay for the different quantities of goods and services gained or sacrificed when choosing the best alternative. Where competitive markets for these goods and services exist, the prices from these markets provide the values to be used in the analysis. Where goods and services are not traded in competitive markets, the analyst can use estimates of what market price would have prevailed had a competitive market existed (e.g., finding out what people are willing to pay for different levels of wilderness preservation, or the "shadow price" of employment when the economy is not in full employment).

6.2 The CBA Method

CBA begins by recognizing that scarcity prevails: there is an economic problem in the sense that human wants exceed the resources available to satisfy them. This necessitates hard choices if society's welfare, however defined, is to be maximized. CBA can help in this process of rational decision making.

CBA is a tool designed to determine whether alternative forms of allocation of our scarce resources make society "better off." The objective of CBA is to determine if the net value of the output in the system with the proposed allocation is greater than the net value of the output under all other possible allocations. This allocation of resources is called an efficient allocation.

Maximum allocative efficiency occurs when it is not possible by altering the configuration of inputs and outputs in the economy to make one or more persons better off without also making someone else worse off. This criterion for allocative efficiency leads to the conclusion that if a change in allocation results in an increase in well being for at least one individual and a decrease in well being for none, then there can be no doubt that such a change should take place. Efficient allocation of resources occurs when we choose options with the highest net benefits.

The measurement of benefits and costs is the analytical heart of cost-benefit analysis. The analyst tries to identify and measure that the full range of consequences of policy alternatives for allocative efficiency. This means that tangible and intangible costs and benefits must be considered, that effects years in the future must be taken into account, and that both market and non-market effects must be incorporated into the analysis. In most cases, the specification of "costs" and "benefits" is a matter of the algebraic sign of the consequences: undesirable consequences are called costs and desirable consequences are called benefits.

In general terms, the measurement of benefits and costs has four steps: identification of the types of effects, quantification in physical terms, dating and monetization.

(1) Specifying the Types of Effects: The measurement of benefits and costs begins with the specification of the types of effects or consequences associated with the proposed allocation. It is essential to understand the relationship between the allocation desired and its consequences. A model may be helpful here, but the place to start is by thinking about the intended beneficial consequences and then the wider "ripple" effects.

(2) Quantification in Physical Terms: Each type of positive or negative effect (benefit or cost) must be quantified in consistent physical terms. If, for example, an objective of land allocation is the preservation of diversity, the consequences of a particular scheme must first be described in the simplest terms, for example, by the number of species retained in the system and the changes in species mixes. The quantification stage must also specify the degree of uncertainty associated with the estimated consequences.

(3) Dating the Benefits and Costs: The third step is to specify the timing of the positive or negative consequences since benefits that will not be received for a decade are not as valuable as those to be received this year. The converse is true of costs, of course.

(4) Reduction to a Common Unit Measure--Monetization: To ensure comparability in evaluating consequences of alternative allocations, all consequences must be converted into a common unit. Dollars serve as a convenient, well-understood unit of value and indeed many of the benefits and costs have a financial dimension. A major problem with using dollars, however, is the reluctance of people to monetize values explicitly, even though in daily life they implicitly do so all the time by deciding how much to spend to promote a specific objective. Note that adjustments in the unit of value must be made to correct for differences in timing and for uncertainties associated with the consequences. This is achieved by discounting and adjusting outcome to reflect risk free equivalent values.

Among the conventions of CBA are:

(1) Measure costs and benefits in constant dollars.

(2) Include only real effects, i.e., effects which increase total production and consumption opportunities and ignore distributional consequences. Regional employment creation, for example, should not count as a benefit if the province has full employment.

(3) Except in some special circumstances, ignore indirect benefits to avoid double counting.

(4) Evaluate "intangible" benefits to ensure comprehensive assessment of the total consumption and production opportunities for society--the opportunities which cost-benefit analysis attempts to maximize.

(5) Use "shadow prices" where competitive markets do not exist.

The assessment of non-market values is probably one of the most difficult problems in assessing comprehensively the costs and benefits associated with alternative allocations of forest land among competing uses.

6.3 Ways to Evaluate Non-Timber Values in CBA

There are several ways to evaluate non-timber values of forest uses.

(1) Contingent Valuation Method (CVM)

CVM attempts to simulate market behaviour by asking consumers through a social survey what they would be willing to pay for a good or service. The value of the good is estimated by multiplying the average willingness to pay by the number of consumers.

Advocates of CVM cite a number of advantages. First, CVM is consistent with the theory of individual choice and welfare measurement. Second, CVM is flexible. The

technique can be modified to incorporate changes in quality, quantity, alternative payment mechanisms, market structures and types of trade-offs related to most non-market situations. This flexibility is reflected in the wide application of CVM to different types of valuation problems ranging from expenditures on reducing risk to wilderness preservation. Third, CVM can incorporate non-user values such as option and existence values into the valuation. Finally, CVM is relatively inexpensive.

The problems with CVM include: (1) people who respond to hypothetical choice situations may have difficulty in expressing their preferences; (2) people may respond to surveys just to participate in the choice process although they may have no firm or strong opinions; (3) people may try to influence results by misrepresenting their true willingness to pay, since they do not actually have to pay; and (4) people may respond to the questionnaire in a way that may bias the result (i.e., how you ask the question may influence the results). Another dilemma is the fact that people respond to questions about willingness to pay for a benefit differently than they respond to how much compensation they require to give up a benefit they have. The alternatives available to the evaluator are (a) to choose a mid-range estimate or (b) to use willingness to pay when benefits are added and willingness to accept compensation or willingness to sell, when the withdrawal of an existing benefit is contemplated.

The application of CVM also requires consideration of aggregation problems since in answering about willingness-to-pay for a specific non-market benefit one does not consider other benefits which are available or might be available as close substitutes. Thus, for example, if the value of wilderness areas is estimated by adding CVM estimates for each separate wilderness area, the process ignores the fact that consumers may view different wilderness areas as substitutes.

To conclude, there are many problems with CVM, but many of these problems can be corrected by careful survey design and tests of robustness by employing alternative survey designs.

(2) Travel Cost Method (TCM)

The underlying concept of the TCM is simple. Travellers to recreation sites incur measurable travelling costs which can be used to estimate the willingness to pay for the site. A principal advantage of TCM is that the data on site visits necessary for calculating values is usually readily available. Consequently, the technique is relatively inexpensive to use. Second, TCM uses actual consumer expenditures to estimate non-market values.

The problems with this method include: (1) the evaluation of the costs of travel time; (2) visit to a site may be part of a multi-destination trip, and thus the costs and benefits should be allocated among destinations; (3) aggregation problems exist (as in the case of CVM); and (4) the method ignores existence and option values.

(3) Hedonic Price Method

The price of a good is a function of a bundle of attributes. The value of a recreation site, for example, is a function of a number of factors such as distance, facilities, availability of recreation activities, environmental quality and scenic value. The difference in attributes allows for the valuation of specific features by using statistical methods to assess the impact of each individual characteristic. For example, a site with good fishing can be compared to other sites which are similar in all respects other than the availability of good fishing. The difference in price can then be used to estimate the value of fishing.

The principal advantage of the hedonic price method is that it uses actual market data to estimate non-market values. Unfortunately, it also has serious disadvantages. First, it is difficult to control for all the significant variables which affect price. Sufficient market data is often simply not available. Second, there are different formulations of the underlying price relationships which give different results. The actual relationship is usually unknown. Third, it assumes perfectly functioning markets. Consumers, however, may have insufficient information on non-market characteristics to accurately assess site attributes. Finally, expectations of future trends are capitalized into existing prices, making it difficult to isolate the effect of any individual characteristic. For these reasons, the hedonic price method has limited applicability.

(4) Conjoint Measurement (CM)

CM is a technique used by marketers. It combines the idea in hedonic pricing (using revealed choice among goods representing different bundles of attributes) with the survey method of contingent valuation methods (i.e., asking people to choose among or rank hypothetical options). Statistical techniques are used to assess trade-offs among the attributes (and if one attribute is price, one obtains the willingness to pay for different attributes).

This technique has the advantage that it does not require direct monetization of benefits and, therefore, can be used to derive trade-offs without reference to market processes. The shortcomings as well as some advantages of the technique are similar to those inherent in CVM (i.e., using survey technique and hypothetical choices).

6.4 Evaluation of Cost-Benefit Analysis

The major advantage of cost-benefit analysis is the provision of a logical, relatively simple way to reach a choice--an accounting system which balances advantages and disadvantages of each alternative to produce an easy to understand common unit of net benefit (dollars). The validity of this accounting system depends on the extent to which market data reveal the true preferences in society and to what extent it is accepted in society that the market process is the appropriate means of registering social preferences. Cost-benefit analysis is open to evaluation and permits sensitivity analysis. The technique is used extensively in government institutions and is widely accepted. The background studies indicate that it is a viable and effective method for assessing tradeoffs between forestry and non-forestry uses.

The major disadvantages of cost-benefit analysis include a need for expensive information and qualified analysts. The comprehensiveness of this technique depends to a large extent on the degree to which non-market consumption values are incorporated into the analysis. Also, given the uncertainty of various inputs, a wide range of sensitivity assumptions have to be incorporated. This can result in a wide range of final results.

If one does not accept economic efficiency as a primary criterion, the most important disadvantage of cost-benefit analysis as a decision tool is its single focus upon the maximization of total consumption and production opportunities for society given the existing distribution of wealth Other impacts important to decision makers such as employment are not explicitly included.

7.0 MULTIPLE ACCOUNT ANALYSIS (MAA)

7.1 The Value Assumptions of MAA

MAA emerged in response to the desire to incorporate important non-efficiency objectives such as employment and biological diversity into the evaluation. The idea is that in the efficiency domain, cost-benefit accounting can reduce complex arrays of consequences for each alternative to a bottom-line performance measure that can be compared to an array of non-efficiency consequences accounts. The trade offs between the "bottom lines" of these accounts in choosing the best alternative are left to the designated decision maker.

From a philosophical point of view MAA combines a measure of plasticity, thus retaining the sovereignty of the decision maker, while accepting and highlighting the value of economic efficiency. In MAA, for example, concerns for regional unemployment may lead to a choice of alternative forest allocation that is inferior in terms of provincial economic performance, but the costs and benefits of such a choice will be made explicit.

7.2 The Method of MAA

MAA incorporates cost-benefit analysis and supplements it with a multiple account framework to display and compare the effects of undertaking alternative courses of action. Evaluation or trade-off analysis is thus facilitated by allowing the decision maker to consider the alternatives in terms of their contributions to different objectives such as national economic development, environmental quality and social well-being.

The original format of MAA was designed to meet the needs of the water planning authorities in the U.S. (specifically the Water Resource Council - WRC). In this

application the following accounts supplemented the cost-benefit analysis or national economic development account.

The Environmental Quality Account (EQ)

The EQ account shows effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be measured in monetary terms. Entries in this account are to be expressed in appropriate numeric and non-numeric terms.

Regional Economic Development Account (RED)

The RED account shows the regional incidence of economic effects, income transfers, and employment effects. This account includes two measures of the effects of the plan on regional economies: regional income and regional employment. Input-output analysis is normally used to evaluate these economic impacts.

The Other Social Effects Account (OSE)

The OSE account shows urban and community impacts and effects on life, health, and safety. This account is expressed in monetary, other numeric or non-numeric terms. The OSE account displays and integrates into the planning process the effects of plan alternatives from perspectives not covered by other accounts.

In 1979, an MAA framework based upon that of the U.S. WRC was recommended for use by the then B.C. Ministry of Lands, Parks and Housing. MAA was seen as a means of incorporating economic, social, and environmental data into the government's planning process to facilitate the allocation of land amongst competing uses.

In this proposed framework, four accounts were used: an efficiency account (the Provincial Income Account) and three non-efficiency accounts (Regional Development,

Environmental Impact and Governmental Income and Expenditures). The establishment of such accounts affords decision makers both a more comprehensive understanding of all of the effects of the alternatives and the ability to understand the trade-offs between alternatives.

7.3 Evaluation of MAA

MAA has several advantages. First, it does not confine measurements to monetary units and therefore avoids the difficult problem of establishing monetary values for non-market goods and services. It incorporates economic, environmental, and social data in a single decision-making framework and thereby provides decision makers with formation for evaluating the effects of alternatives in terms of their relative contributions to economic, social and environmental objectives. It is adaptable in that it can accommodate any number of account types, and the same framework can be used with more or less emphasis placed on any of the objectives. It also allows the decision maker to use discretion in weighting the objectives. It allows for the consideration of the disparate interests of regional and provincial spatial scales. It is comprehensive because it utilizes the expertise of many disciplines and levels of government. It condenses disparate data in an internally consistent framework so that alternatives can be compared according to their contributions to various objectives.

The limitations of MAA are: It does not result in an explicit decision criterion as does a strict cost-benefit analysis. It only displays the effects of taking alternative courses of action to facilitate trade-off analysis. Judgments on the part of the decision makers are still necessary, but can be formalized in a process similar to the derivation of a utility function in decision analysis. It is complex, time-consuming and expensive. It requires the coordinated effort of a number of disciplines and levels of government and also entails the collection of large amounts of data (some of which may not be readily available). The use

of MAA does not eliminate issues posed by cost-benefit analysis such as the choice of discount rate and time frame for analysis and the valuation of intangibles for the National Economic Development Account. It poses further issues for consideration such as which accounts should be included or excluded, and what constitutes environmental quality or social well-being.

8.0 CONCLUSIONS

It is widely agreed that public forest land in B.C. should be allocated so as to maximize the net benefit to society as a whole. This means:

(1) incorporation of social values in the decision process articulated as preferences and trade-offs among conflicting objectives;
(2) the use of the most appropriate data base and technical and scientific know-how to the extent practicable;
(3) the explicit recognition of the role of assumption making and other sources of uncertainty in the analysis and choice process.

Comprehensive multiple account analysis provides a framework of choice that satisfies these criteria. An analytic standardized framework for MAA for forest land allocation among competing uses should incorporate the principles of a biophysical land classification as part of its integrated geographical information system, the methods of decision analysis to structure and define trade offs among accounts to formalize its decision component, and cost-benefit analysis principles to ensure economic allocative efficiency where such an efficiency criterion is appropriate.

To be comprehensive, the framework must consider all advantages and disadvantages associated with an alternative and be able to reduce them to a common unit that reflects social trade-offs among multiple objectives. This means that no important advantage (benefit) or disadvantage (cost) dimensions can be excluded from the analysis as intangible or unquantifiable. Indeed, whenever "trade-offs" are made by society with respect to a benefit or a cost, it is possible to quantify its value in terms of this "trade-off." The willingness-to-pay principle is central to such quantification. If "trade-offs" are not acceptable with respect to some outcomes (e.g., unacceptable environmental risks), such constraints must be identified explicitly and used as screening devices to eliminate alternatives. It is, however, desirable to assess the "costs" of such constraints to society in terms of other objectives.

Given the importance of social values and assumption making in the application of multiple account analysis to the problem of forest land allocation, public participation is necessary. This participation can take the form of:

(1) Surveys of the preferences of the public to establish value units reflecting trade-offs through willingness-to-pay evaluation.

(2) Open public hearings to generate alternatives and inform the public about the process and its outcomes.

(3) The use of advisory committees with representation of a variety of stakeholders to ensure:

    (a) the comprehensive consideration of all value dimensions involved in forest allocation;
    (b) the generation of imaginative forest land allocation options;
    (c) the scrutinization of assumption making; and
    (d) the highlighting of "equity" problems.

To ensure systematic and comprehensive application of MAA for decision making, it is necessary to develop standardized operational guidelines for forest land allocation in B.C. for each account, including specification of assumptions, measurement methods, and analytic procedures (e.g., requirements for sensitivity analysis). Given the expense of using MAA it is important, however, that such guidelines reflect the stakes associated with a decision. In cases where the stakes are low, or agreement on allocation can be reached without much conflict, the analysis should be simplified or preempted using simpler and less expensive methodologies.

9.0 RECOMMENDATIONS

(1) The Province of British Columbia should develop a comprehensive multiple account framework based on the U.S. Water Resources Council accounts system. The framework should identify the accounts and provide guidelines on how the various accounts should be prepared.

(2) To assist in the implementation of a multiple accounts framework, geographical information systems should be integrated with existing growth and yield models and the provincial input output model to provide an integrated model for estimating the impacts of alternative land use decisions. Common guidelines should be used by all agencies involved in data collection to ensure consistency and compatibility of data sets.